

Figure 1: System Model

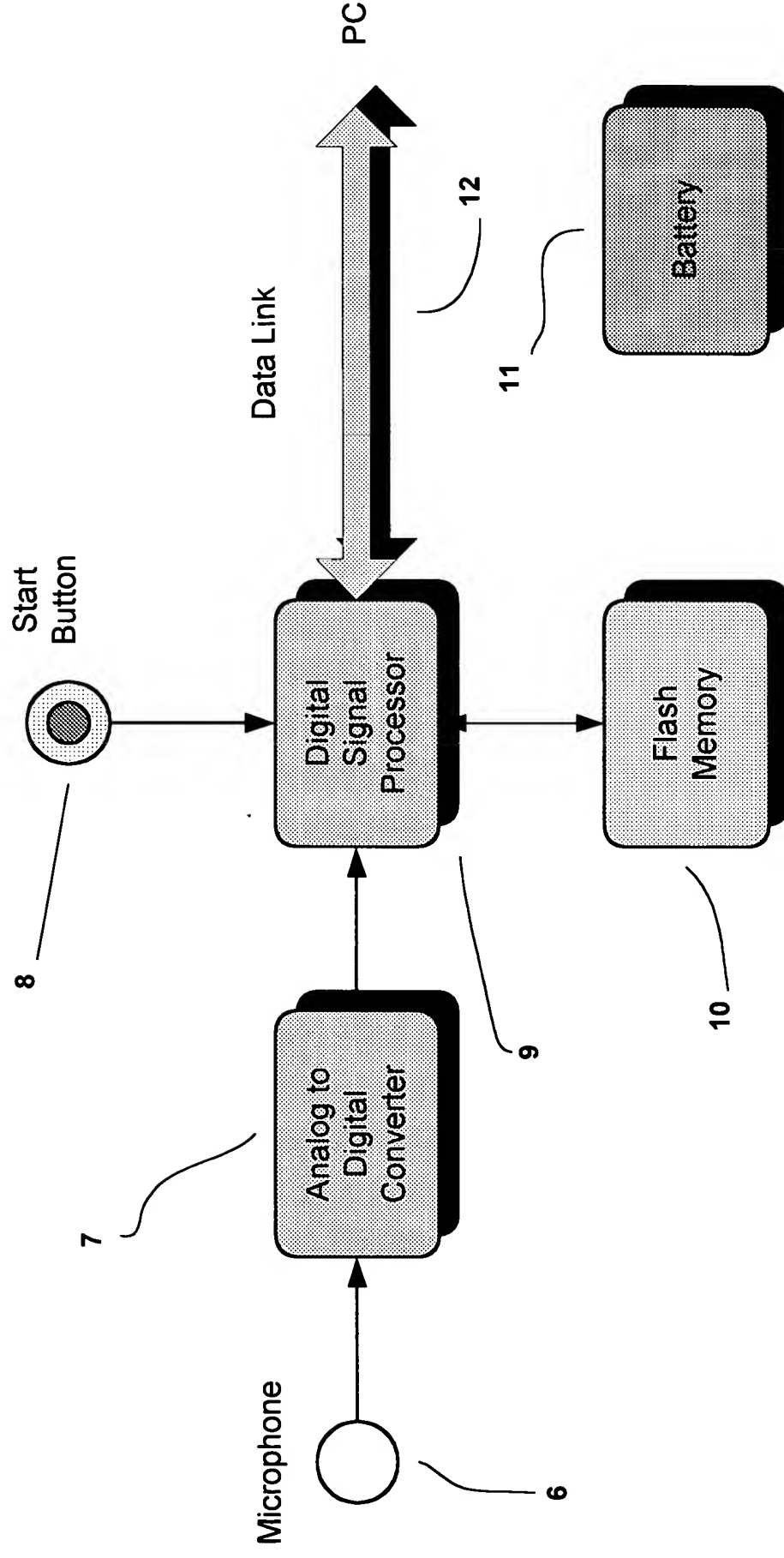


Figure 2: Typical Audio Capture Device

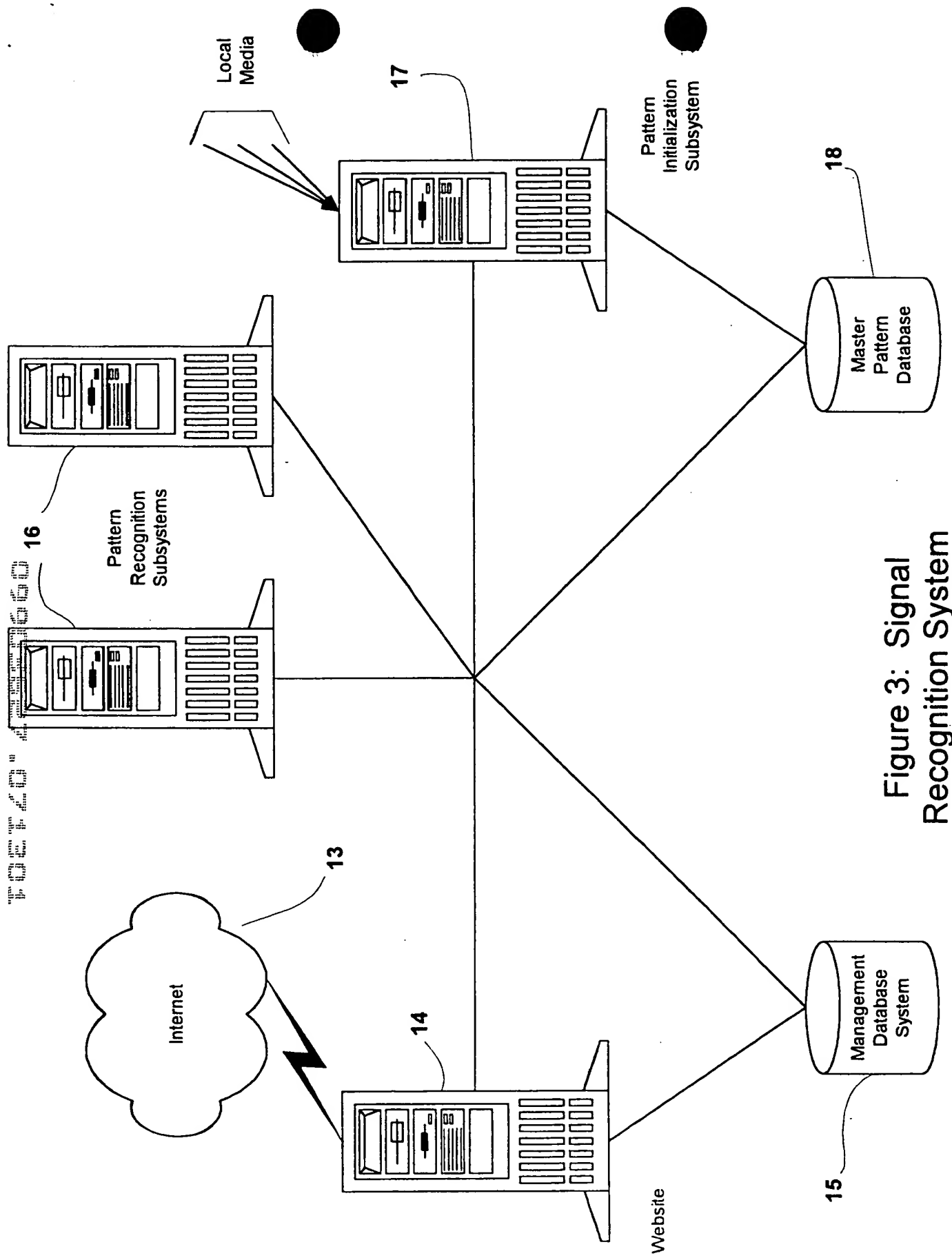


Figure 3: Signal Recognition System

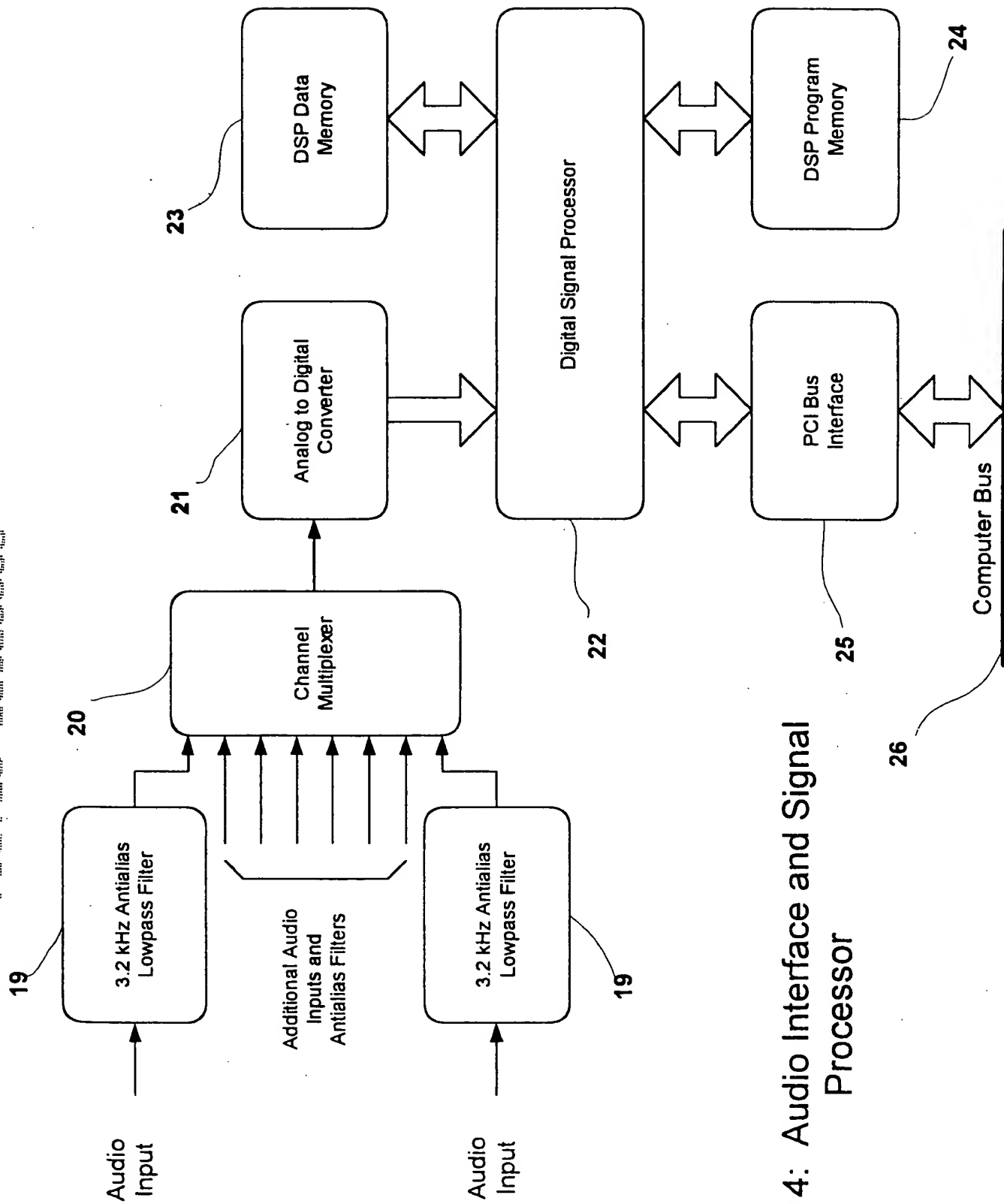


Figure 4: Audio Interface and Signal Processor

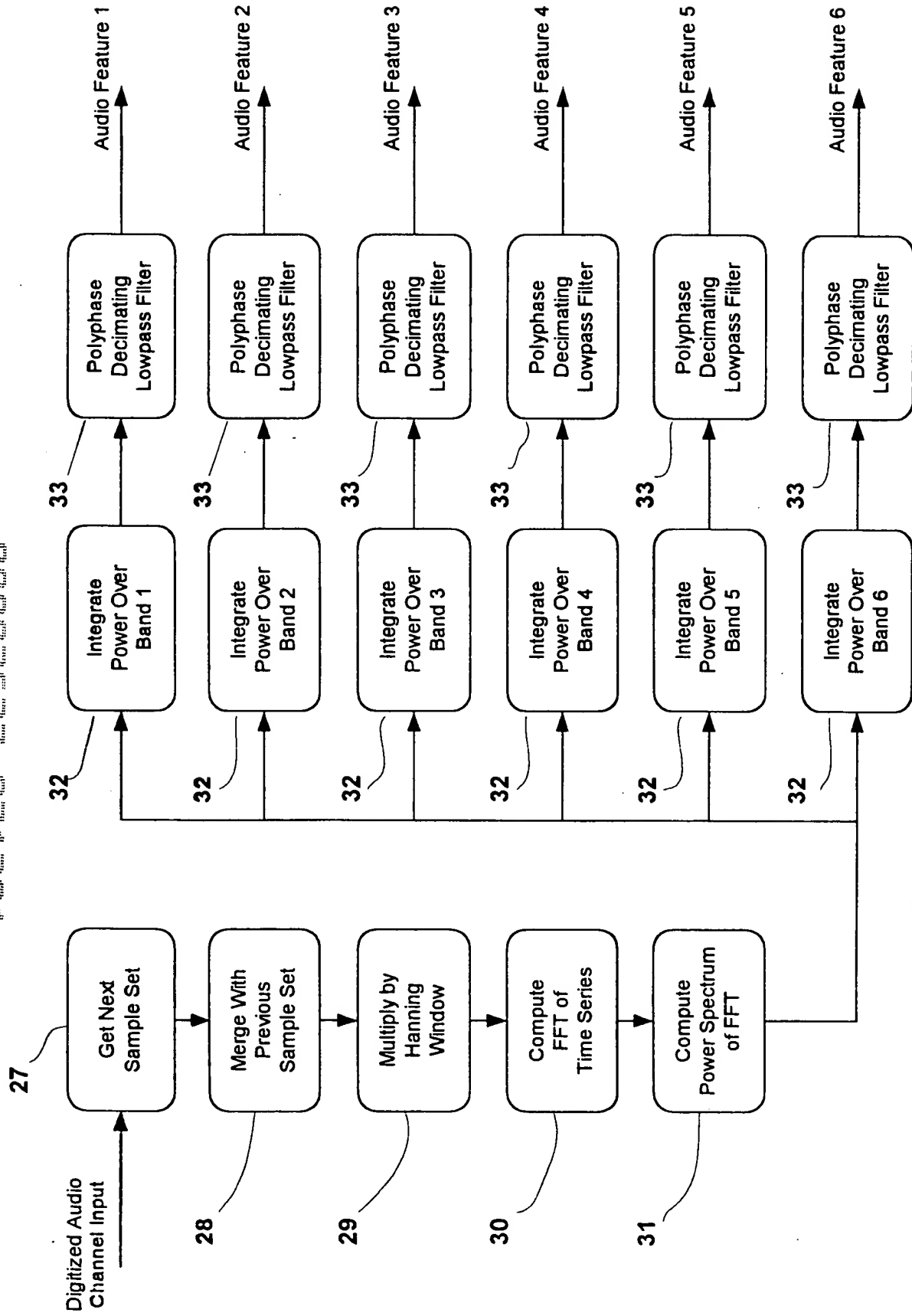


Figure 5: Audio Spectrum Analysis and Feature Extraction

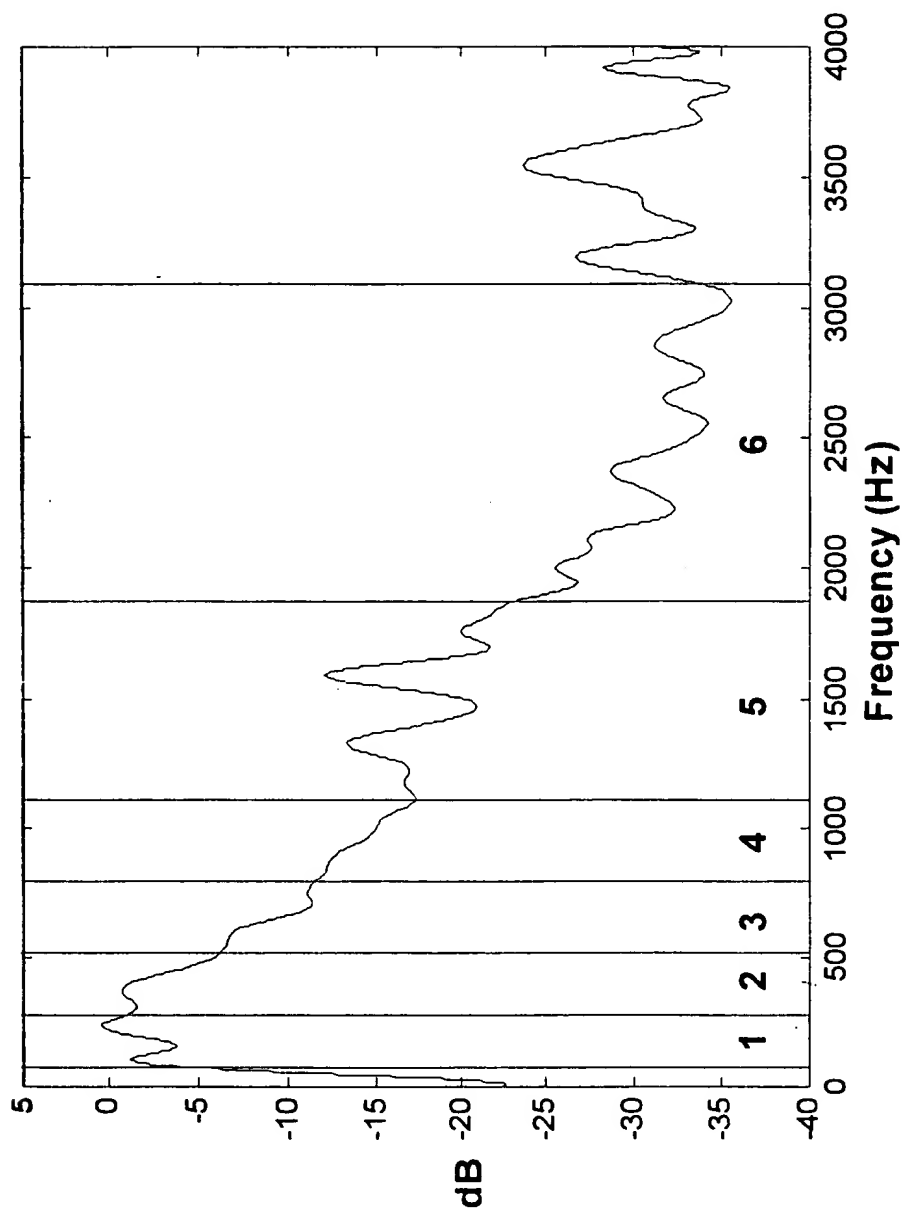


Figure 6: Audio Spectrum Analysis Bands

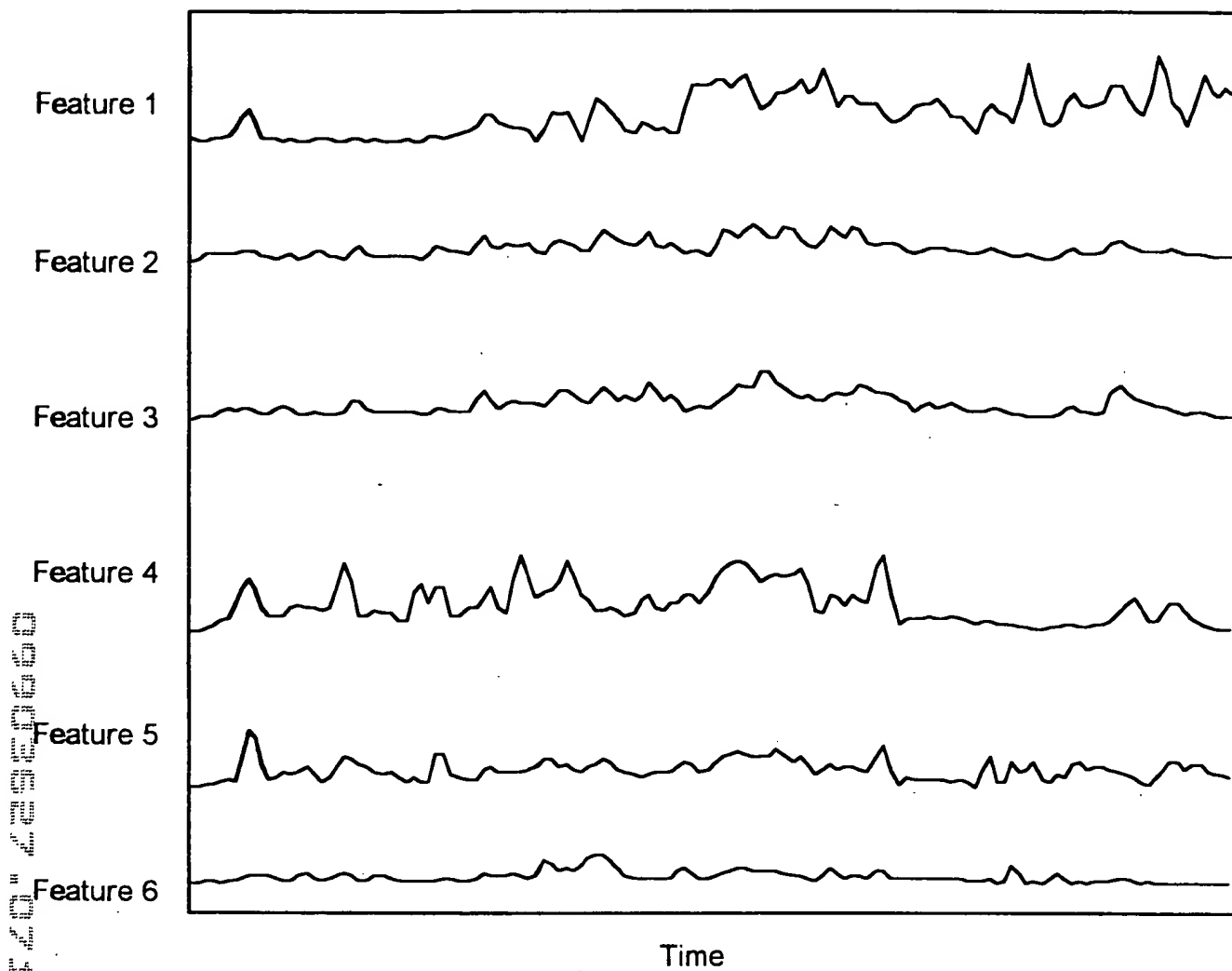


Figure 7: Example Feature Waveforms

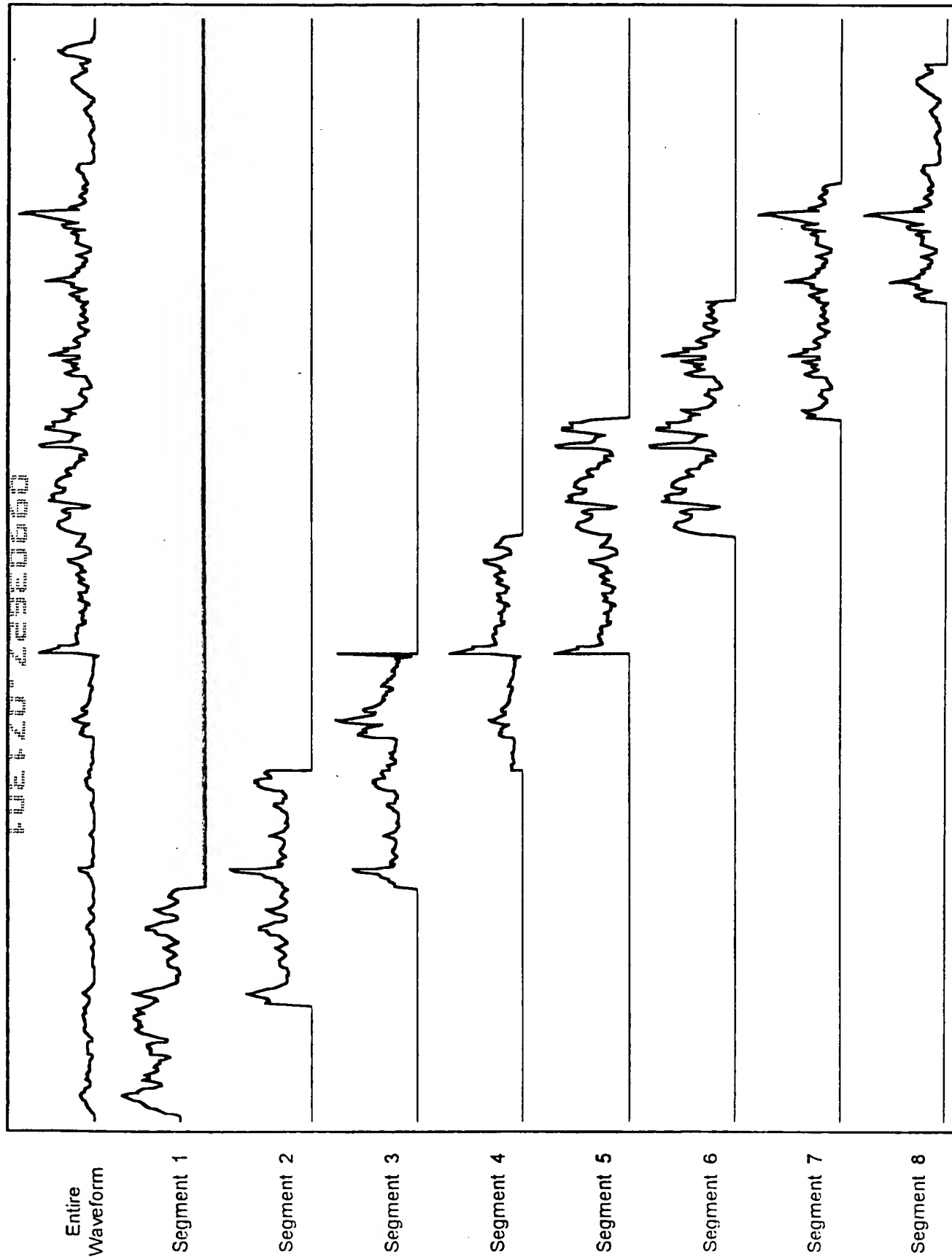


Figure 8: Reference Feature Waveform Segmentation



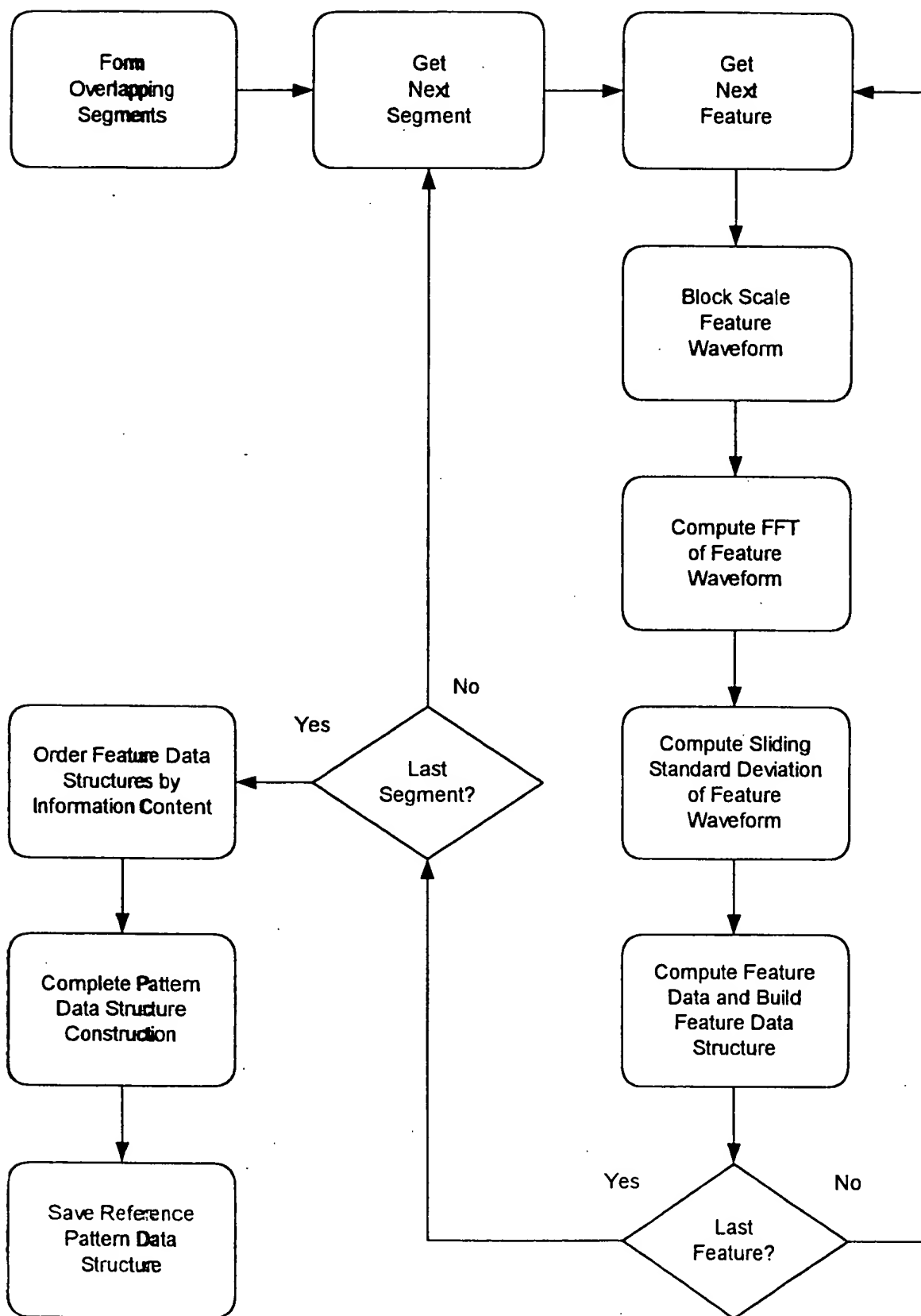


Figure 9: Reference Pattern Initialization

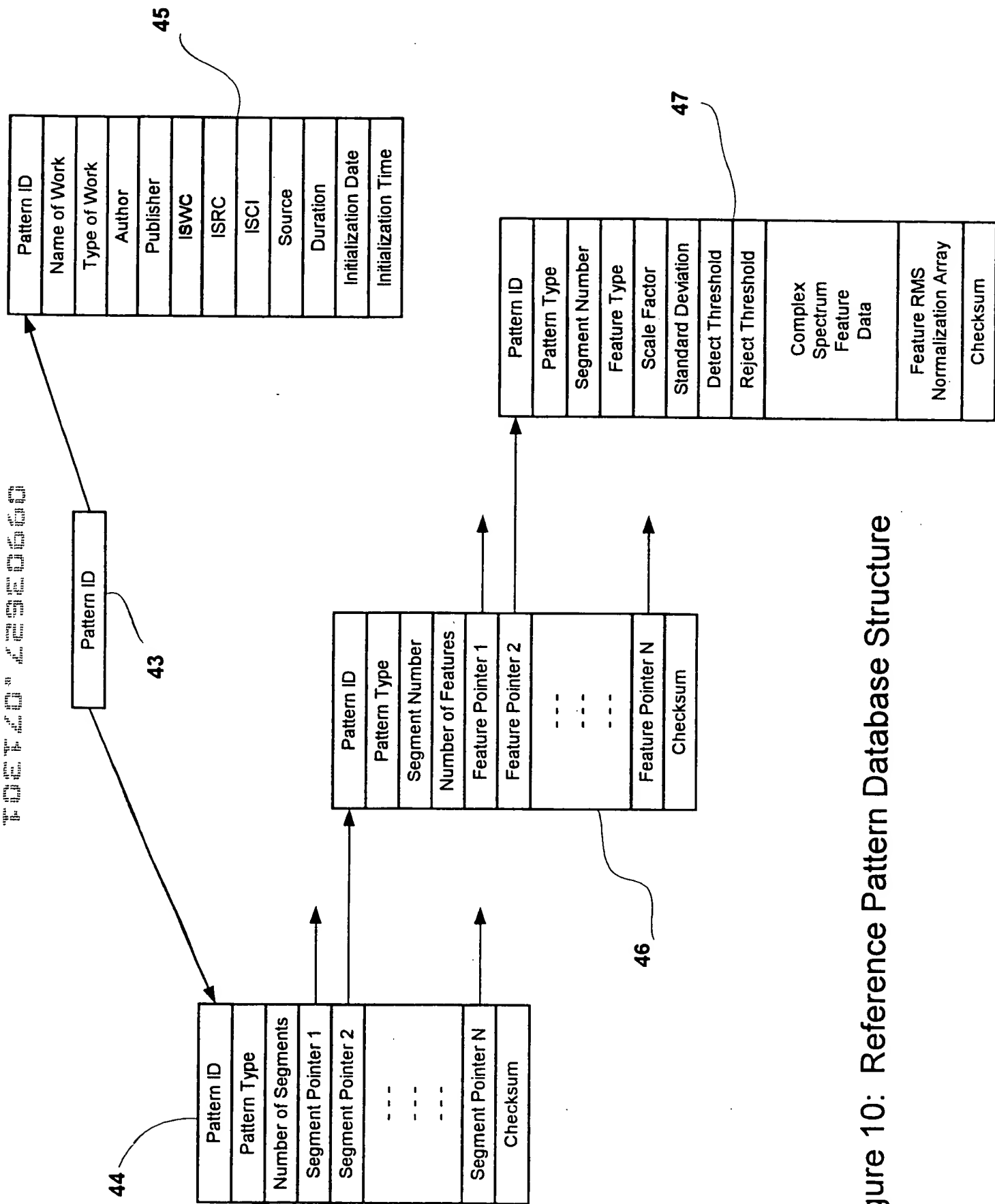


Figure 10: Reference Pattern Database Structure

Input Feature Data

Get  
Input Feature  
Block

Remove Mean  
From Each  
Feature

Normalize  
Each Feature  
in Block

Pad Each  
Feature  
with Zeroes

Compute FFT  
of Each  
Feature

Pattern Matching Process

Figure 11: Real-Time Feature Block Pre-Processing

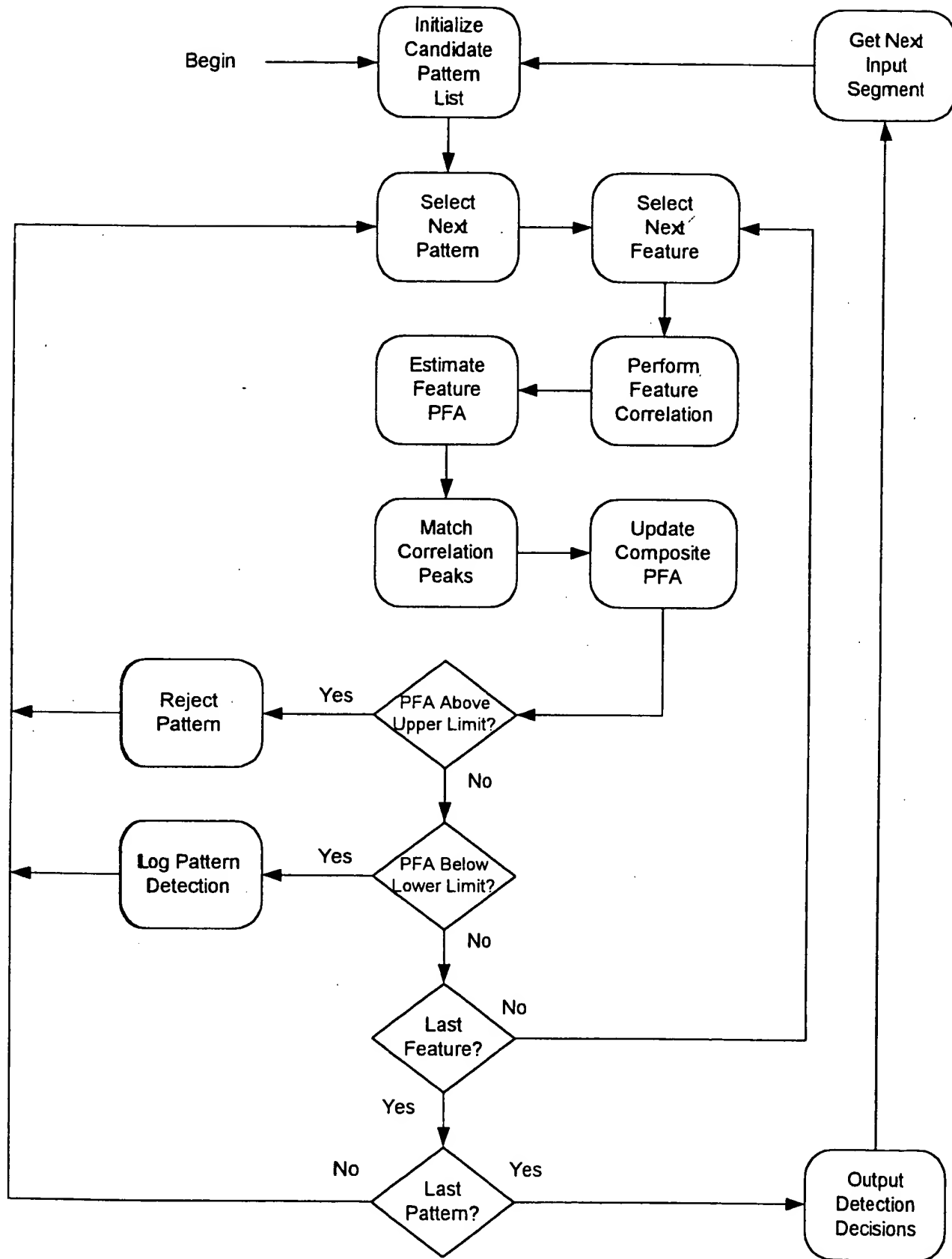


Figure 12: Multiple Feature Correlation Process

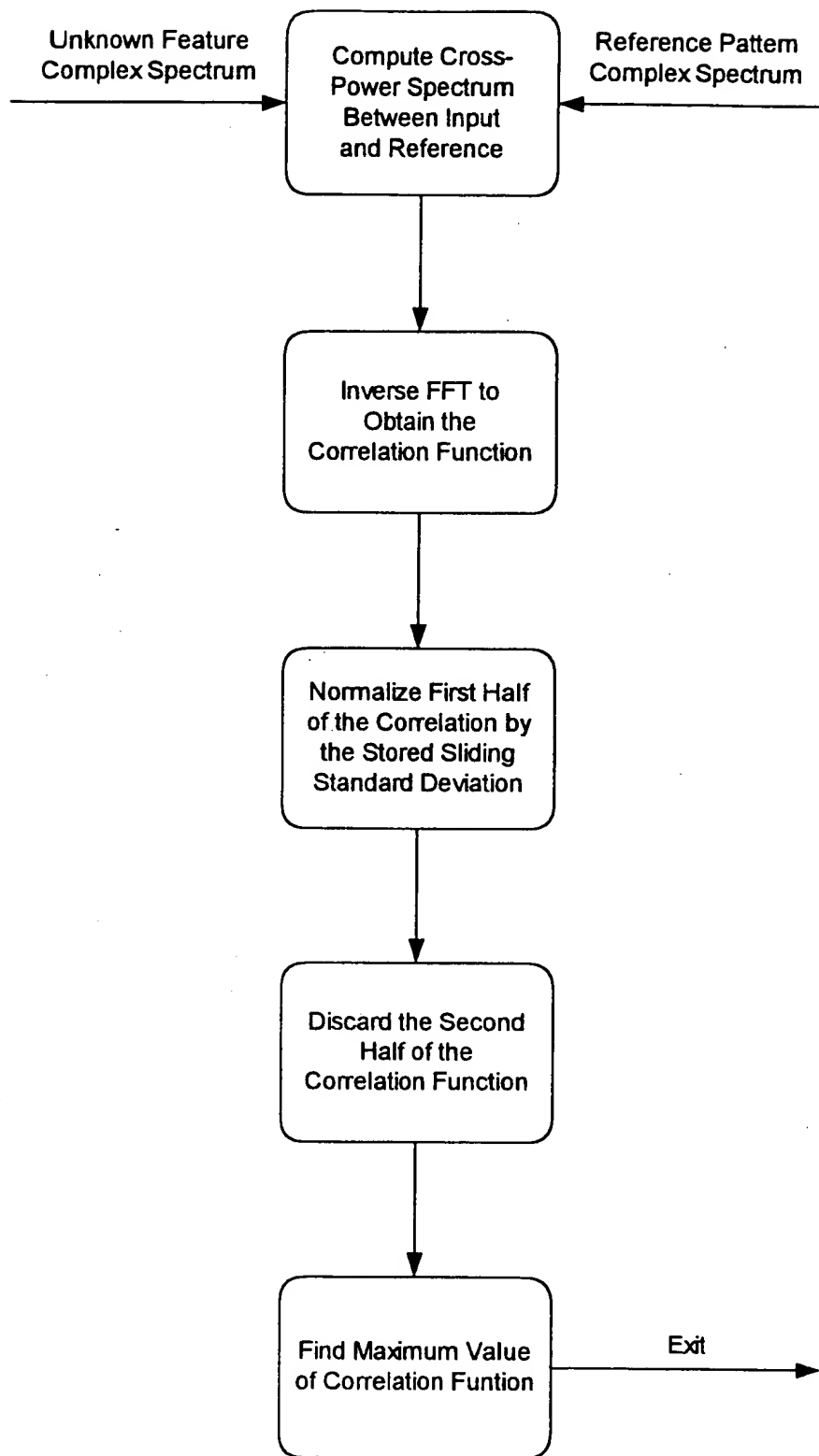


Figure 13: Feature Correlation Process

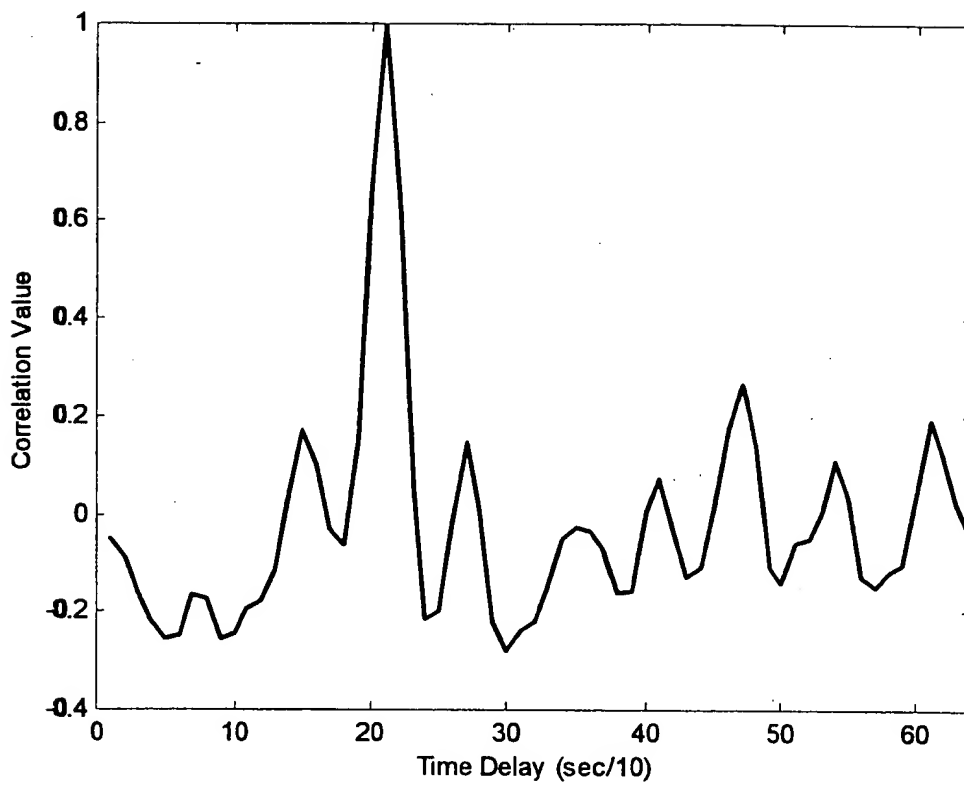


Figure 14: Example Feature Correlation Function

Probability Density Function of Feature Correlation Values

Cumulative Probability of Feature Correlation Values

Probability of False Alarm

Standard Deviations from Mean

Probability of False Feature Detection  
 $PFA = 1 - \text{cdf}(\text{correlation peak} / \sigma)$

(C)

### Figure 15: False Detection Estimation from Correlation Values